

SCOPE OF CLAIMS

1. A transmission time difference measurement method in a system having a terminal, two or more base stations that each operate asynchronously, and a control device for controlling the terminal and each of the base stations, said method calculating transmission time differences of signals in each of said base stations and comprising steps wherein:
 - 5 when said terminal is able to simultaneously receive signals from each of said base stations,
 - each of said base stations uses a round trip time measurement function to measure the round trip times of signals to and from said terminal;
 - 10 said terminal uses a turn-around time measurement function to measure, for each of said base stations, the turn-around time from the reception of a signal from the base station until the transmission of a signal to that base station;
 - 15 said terminal uses an arrival time difference measurement function to measure the arrival time difference, which is the difference between the times that signals arrive from each of said base stations; and
 - 20 said control device finds the difference in transmission times of signals in each of said base stations based on: the difference of propagation times between said terminal and each of said base stations that is calculated by subtracting the turn-around time that is measured in said terminal from the round trip time that is measured in each of said base stations, and the arrival time difference that is measured in said terminal; and uses a storage function to store the calculated transmission time differences in association with the calculation times at which the transmission time differences were calculated.

2. The transmission time difference measurement method according to claim 1, wherein each of said terminal, said base stations, and said control device carries out the processes of said steps only when said terminal is able to simultaneously receive signals from each of said base stations, and

5 moreover, when said terminal is a specific terminal that satisfies predetermined conditions.

3. The transmission time difference measurement method according to claim 2, wherein, as said predetermined conditions, said turn-around time measurement function and said arrival time difference measurement function of said terminal can be realized with measurement accuracy that equals or

5 exceeds measurement accuracy that has been prescribed in advance.

4. The transmission time difference measurement method according to claim 2, wherein, as said predetermined conditions, the number of times that said terminal has used said turn-around time measurement function and said arrival time difference measurement function to carry out measurements

5 satisfies a predetermined condition.

5. The transmission time difference measurement method according to claim 2, further comprising a step wherein said terminal uses a reception quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, said reception quality that has been measured using said reception quality measurement function of said terminal satisfies a predetermined condition.

6. The transmission time difference measurement method according to claim 2, wherein, as said predetermined conditions, the transmission time differences of each of said base stations that have not been stored using said

storage function, or the difference between the current time and said
5 calculation time of said transmission time differences that have been stored
using said storage function satisfies a predetermined condition.

7. The transmission time difference measurement method according
to claim 2, wherein, as said predetermined conditions, said turn-around time
measurement function and said arrival time difference measurement function of
said terminal can be realized with measurement accuracy that equals or
5 exceeds measurement accuracy that has been prescribed in advance, and
moreover, the number of times that said terminal uses said turn-around time
measurement function and said arrival time difference measurement function to
carry out measurements satisfies a predetermined condition.

8. The transmission time difference measurement method according
to claim 2, further comprising a step wherein said terminal uses a reception
quality measurement function to measure the reception quality of signals
received from each of said base stations;
5 wherein, as said predetermined conditions, said turn-around time
measurement function and said arrival time difference measurement function of
said terminal can be realized with measurement accuracy that equals or
exceeds measurement accuracy that has been prescribed in advance, and
moreover, said reception quality that has been measured using said reception
10 quality measurement function of said terminal satisfies a predetermined
condition.

9. The transmission time difference measurement method according
to claim 2, wherein, as said predetermined conditions, said turn-around time
measurement function and said arrival time difference measurement function of
said terminal can be realized with measurement accuracy that equals or

5 exceeds measurement accuracy that has been prescribed in advance, and
moreover, the transmission time differences of each of said base stations that
have not been stored using said storage function, or the difference between the
current time and said calculation time of said transmission time differences that
have been stored using said storage function satisfies a predetermined
10 condition.

10. The transmission time difference measurement method according
to claim 2, further comprising a step wherein said terminal uses a reception
quality measurement function to measure the reception quality of signals
received from each of said base stations;

5 wherein, as said predetermined conditions, the number of times that
said terminal has used said turn-around time measurement function and said
arrival time difference measurement function to carry out measurements
satisfies a predetermined condition, and moreover, said reception quality that
has been measured using said reception quality measurement function of said
10 terminal satisfies a predetermined condition.

11. The transmission time difference measurement method according
to claim 2, wherein as said predetermined conditions, the number of times that
said terminal has used said turn-around time measurement function and said
arrival time difference measurement function to carry out measurements
5 satisfies a predetermined condition, and moreover, the transmission time
differences of each of said base stations that have not been stored using said
storage function, or the difference between the current time and said
calculation time of said transmission time differences that have been stored
using said storage function satisfies a predetermined condition.

12. The transmission time difference measurement method according to claim 2, further comprising a step wherein said terminal uses a reception quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, said reception quality that has been measured using said reception quality measurement function of said terminal satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored using said storage function, or the difference between the current time and said 10 calculation time of said transmission time differences that have been stored using said storage function satisfies a predetermined condition.

13. The transmission time difference measurement method according to claim 2, further comprising a step wherein said terminal uses a reception quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, said turn-around time measurement function and said arrival time difference measurement function of said terminal can be realized with measurement accuracy that equals or exceeds measurement accuracy that has been prescribed in advance, the number of times that said terminal has used said turn-around time 10 measurement function and said arrival time difference measurement function to carry out measurements satisfies a predetermined condition, and moreover, said reception quality that has been measured using said reception quality measurement function of said terminal satisfies a predetermined condition.

14. The transmission time difference measurement method according to claim 2, wherein, as said predetermined conditions, said turn-around time

measurement function and said arrival time difference measurement function of said terminal can be realized with measurement accuracy that equals or 5 exceeds measurement accuracy that has been prescribed in advance, the number of times that said terminal has used said turn-around time measurement function and said arrival time difference measurement function to carry out measurements satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not 10 been stored using said storage function, or the difference between the current time and said calculation time of said transmission time differences that have been stored using said storage function satisfies a predetermined condition.

15. The transmission time difference measurement method according to claim 2, further comprising a step wherein said terminal uses a reception quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, the number of times that said terminal has used said turn-around time measurement function and said arrival time difference measurement function to carry out measurements satisfies a predetermined condition, said reception quality that has been measured using said reception quality measurement function of said terminal 10 satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored using said storage function, or the difference between the current time and said calculation time of said transmission time differences that have been stored using said storage function satisfies a predetermined condition.

16. The transmission time difference measurement method according to claim 2, further comprising a step wherein said terminal uses a reception

quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, said turn-around time measurement function and said arrival time difference measurement function of said terminal can be realized with measurement accuracy that equals or exceeds measurement accuracy that has been prescribed in advance, the number of times that said terminal has used said turn-around time

10 measurement function and said arrival time difference measurement function to carry out measurements satisfies a predetermined condition, said reception quality that has been measured using said reception quality measurement function of said terminal satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been

15 stored using said storage function, or the difference between the current time and said calculation time of said transmission time differences that have been stored using said storage function satisfies a predetermined condition.

17. The transmission time difference measurement method according to claim 1, wherein, when said control device has already used said storage function to store transmission time differences,

5 said control device calculates the average value of said transmission time differences that have already been stored using said storage function and said transmission time differences that have been calculated, and uses said storage function to store the average value that has been calculated as said transmission time differences.

18. The transmission time difference measurement method in a system having a terminal, two or more base stations that each operate asynchronously, and a control device for controlling the terminal and each of

the base stations, said method calculating the differences in transmission times
5 of signals in each of said base stations and comprising steps wherein:

when said terminal is able to simultaneously receive signals from each
of said base stations,

10 said terminal uses an arrival time difference measurement function to
measure the arrival time difference, which is the difference between the times
that signals arrive from each of said base stations, and, using a GPS
positioning function, uses signals from a GPS satellite to specify the
geographical location of said terminal; and

15 said control device calculates the distances between said terminal and
each of said base stations based on the geographical location of said terminal
and the geographical locations of each of said base stations that have been
measured by said terminal, finds the transmission time differences of each of
said base stations based on the propagation time differences that are
calculated by diving the differences between the calculated distances by the
speed of light and the arrival time differences that are measured at said
20 terminal, and uses the storage function to store the transmission time
differences that have been calculated in associated with the calculation time at
which the transmission time differences were calculated.

19. The transmission time difference measurement method according
to claim 18, wherein each of said terminal and said control device carries out
the processes of said steps only when said terminal can simultaneously
receive signals from each of said base stations, and moreover, said terminal is
5 a specific terminal that satisfies predetermined conditions.

20. The transmission time difference measurement method according
to claim 19, further comprising a step wherein said terminal uses a reception

quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, said reception quality that is measured using said reception quality measurement function of said terminal satisfies a predetermined condition.

21. The transmission time difference measurement method according to claim 19, wherein, as said predetermined conditions, the transmission time differences of each of said base stations that have not been stored using said storage function, or the difference between the current time and said 5 calculation time of said transmission time differences that have been stored using said storage function satisfies a predetermined condition.

22. The transmission time difference measurement method according to claim 19, further comprising a step wherein said terminal uses a reception quality measurement function to measure the reception quality of signals received from each of said base stations;

5 wherein, as said predetermined conditions, said reception quality that has been measured using said reception quality measurement function of said terminal satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored using said storage function, or the difference between the current time and said 10 calculation time of said transmission time differences that have been stored using said storage function satisfies a predetermined condition.

23. The transmission time difference measurement method according to claim 18, wherein, when said control device has already used said storage function to store said transmission time differences,

5 said control device calculates the average value of said transmission time differences that have already been stored using said storage function and said transmission time differences that have been calculated, and uses said storage function to store the average value that has been calculated as said transmission time difference.

24. A transmission time difference measurement system comprising a terminal, two or more base stations that each operate asynchronously, and a control device for controlling said terminal and each of said base stations, said system calculating the transmission time differences of signals in each of said 5 base stations; wherein:

10 said control device includes: a measurement request means for issuing requests for measurement to said terminal and said base stations; and storage means for storing the transmission time differences of signals of said base stations in association with calculation times at which said transmission time differences have been calculated;

15 each of said base stations includes a round trip time measurement means for, upon receiving a measurement request that said control device has transmitted using said measurement request means, measuring the round trip times of signals transmitted to and from said terminal; and

20 said terminal includes: a turn-around time measurement means for, upon receiving a measurement request that said control device has transmitted using said measurement request means, measuring the turn-around time for receiving signals from said base stations until transmitting the signals to said base stations; and an arrival time difference measurement means for measuring the arrival time difference, which is the difference between the times at which signals from at least two base stations arrive;

and wherein, when said terminal is able to simultaneously receive signals from each of said base stations:

25 each of said base stations carries out a process of using said round trip time measurement means to measure each of the round trip times;

 said terminal carries out processes of using said turn-around time measurement means to measure turn-around times for each of said base stations and of using said arrival time difference measurement means to measure arrival time differences; and

30 said control device carries out processes of: finding the transmission time differences of signals in each of said base stations based on the propagation time differences between said terminal and each of said base stations that are calculated by subtracting the turn-around time that is measured in said terminal from the round trip times that have been measured 35 in each of said base stations, and the arrival time difference that is measured in said terminal; and storing in said storage means the transmission time differences that have been calculated.

25. The transmission time difference measurement system according to claim 24, wherein said terminal, each of said base stations, and said control device carry out said processes only when said terminal is able to simultaneously receive signals from each of said base stations, and moreover, 5 when said terminal is a specific terminal that satisfies predetermined conditions.

26. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal are able to measure with measurement accuracy that equals or 5 exceeds measurement accuracy that has been prescribed in advance.

27. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, the number of times that said terminal uses said turn-around time measurement means and said arrival time difference measurement means to carry out measurements 5 satisfies a predetermined condition.

28. The transmission time difference measurement system according to claim 25, wherein said terminal further includes a reception quality measurement means for measuring the reception quality of signals received from each of said base stations; 5 wherein, as said predetermined conditions, said reception quality that has been measured using said reception quality measurement means of said terminal satisfies a predetermined condition.

29. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, the transmission time differences of each of said base stations that have not been stored in said storage means, or the difference between the current time and said calculation time of said transmission time differences that have been stored in said storage means satisfies a predetermined condition. 5

30. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal are able to carry out measurements with measurement accuracy 5 that equals or exceeds measurement accuracy that has been prescribed in advance, and moreover, the number of times that said terminal uses said turn-around time measurement means and said arrival time difference

measurement means to carry out measurements satisfies a predetermined condition.

31. The transmission time difference measurement system according to claim 25, wherein said terminal further includes reception quality measurement means for measuring the reception quality of signals received from each of said base stations; and

5 wherein, as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal are able to measure with measurement accuracy that equals or exceeds measurement accuracy that has been prescribed in advance, and moreover, said reception quality that has been measured using said reception 10 quality measurement means of said terminal satisfies a predetermined condition.

32. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal can carry out measurements with measurement accuracy that 5 equals or exceeds measurement accuracy that has been prescribed in advance, and moreover, the transmission time differences of each of said base stations that have not been stored in said storage means, or the difference between the current time and said calculation time of said transmission time differences that have been stored in said storage means satisfies a 10 predetermined condition.

33. The transmission time difference measurement system according to claim 25, wherein said terminal further includes reception quality

measurement means for measuring the reception quality of signals received from each of said base stations; and

5 wherein, as said predetermined conditions, the number of times that said terminal uses said turn-around time measurement means and said arrival time difference measurement means to carry out measurements satisfies a predetermined condition, and moreover, said reception quality that has been measured using said reception quality measurement means of said terminal
10 satisfies a predetermined condition.

34. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, the number of times that said terminal uses said turn-around time measurement means and said arrival time difference measurement means to carry out measurements
5 satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored in said storage means, or the difference between the current time and said calculation time of said transmission time differences that have been stored in said storage means satisfies a predetermined condition.

35. The transmission time difference measurement system according to claim 25, wherein said terminal further includes reception quality measurement means for measuring the reception quality of signals received from each of said base stations; and

5 as said predetermined conditions, said reception quality that has been measured using said reception quality measurement means of said terminal satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored in said storage means, or the difference between the current time and said calculation

10 time of said transmission time differences that have been stored in said storage means satisfies a predetermined condition.

36. The transmission time difference measurement system according to claim 25, wherein said terminal further includes reception quality measurement means for measuring the reception quality of signals received from each of said base stations; and

5 as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal can carry out measurements with measurement accuracy that equals or exceeds measurement accuracy that has been prescribed in advance, the number of times that said terminal uses said turn-around time measurement means and said arrival time difference measurement means to carry out measurements satisfies a predetermined condition, and moreover, said reception quality that has been measured using said reception quality measurement means of said terminal satisfies a predetermined condition.

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37. The transmission time difference measurement system according to claim 25, wherein, as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal can carry out measurements with measurement accuracy that equals or exceeds measurement accuracy that has been prescribed in advance, the number of times that said terminal uses said turn-around time measurement means and said arrival time difference measurement means to carry out measurements satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored in said storage means, or the difference between the current time

and said calculation time of said transmission time differences that have been stored in said storage means satisfies a predetermined condition.

38. The transmission time difference measurement system according to claim 25, wherein said terminal further includes reception quality measurement means for measuring the reception quality of signals received from each of said base stations; and

5 as said predetermined conditions, the number of times that said terminal uses said turn-around time measurement means and said arrival time

difference measurement means to carry out measurements satisfies a

predetermined condition, said reception quality that has been measured using said reception quality measurement means of said terminal satisfies a

10 predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored in said storage means, or

the difference between the current time and said calculation time of said transmission time differences that have been stored in said storage means satisfies a predetermined condition.

39. The transmission time difference measurement system according to claim 25, wherein said terminal further includes reception quality measurement means for measuring the reception quality of signals received from each of said base stations; and

5 as said predetermined conditions, said turn-around time measurement means and said arrival time difference measurement means of said terminal can carry out measurements with measurement accuracy that equals or exceeds measurement accuracy that has been prescribed in advance, the

number of times that said terminal uses said turn-around time measurement means and said arrival time difference measurement means to carry out

10

measurements satisfies a predetermined condition, said reception quality that has been measured using said reception quality measurement means of said terminal satisfies a predetermined condition, and moreover, the transmission time differences of each of said base stations that have not been stored in said storage means, or the difference between the current time and said calculation time of said transmission time differences that have been stored in said storage means satisfies a predetermined condition.

40. The transmission time difference measurement system according to claim 24, wherein, when said transmission time differences are already stored in said storage means, said control means calculates the average value of said transmission time differences that are already stored in said storage means and said transmission time differences that have been calculated, and stores this calculated average value in said storage means as said transmission time differences.

41. The transmission time difference measurement system comprising a terminal, two or more base stations that each operate asynchronously, and a control device for controlling said terminal and each of said base stations, said system calculating the transmission time differences of signals in each of said base stations; wherein:

10 said control device includes: a measurement request means for issuing requests for measurement to said terminal; and storage means for storing the transmission time differences of signals of said base stations in association with calculation times at which said transmission time differences have been calculated;

said terminal includes an arrival time difference measurement means for, upon receiving a measurement request that said control device has transmitted

using said measurement request means, measuring the arrival time difference, which is the difference between the times at which signals from at least two
15 base stations arrive; and

at least one of said terminal and said control device includes a GPS positioning means for using signals from a GPS satellite to specify the geographical location of terminals;

20 and wherein, when said terminal is able to simultaneously receive signals from each of said base stations:

25 said terminal carries out a process of using said arrival time difference measurement means to measure the arrival time difference;

at least one of said terminal and said control device carries out a process of using said GPS positioning means to specify the geographical
25 location of terminals; and

30 said control device carries out processes of: calculating the distances between said terminal and each of said base stations based on the geographical location of said terminal and the geographical locations of each of said base stations that have been measured, finds the transmission time differences of each of said base stations based on the propagation time difference that is calculated by dividing the differences in calculated distances by the speed of light and the arrival time difference that has been measured at said terminal, and storing the transmission time differences that have been calculated in said storage means.

42. The transmission time difference measurement system according to claim 41, wherein each of said terminal and said control device carry out said processes only when said terminal is able to simultaneously receive

signals from each of said base stations, and moreover, when said terminal is a
5 specific terminal that satisfies predetermined conditions.

43. The transmission time difference measurement system according
to claim 42, wherein said terminal further includes a reception quality
measurement means for measuring reception quality of signals received from
each of said base stations; and

5 wherein, as said predetermined conditions, said reception quality that
has been measured using said reception quality measurement means of said
terminal satisfies a predetermined condition.

44. The transmission time difference measurement system according
to claim 42, wherein, as said predetermined conditions, the transmission time
differences of each of said base stations that have not been stored in said
storage means, or the difference between the current time and said calculation
5 time of said transmission time differences that have been stored in said storage
means satisfies a predetermined condition.

45. The transmission time difference measurement system according
to claim 42, wherein said terminal further includes a reception quality
measurement means for measuring reception quality of signals received from
each of said base stations; and

5 wherein, as said predetermined conditions, said reception quality that
has been measured using said reception quality measurement means of said
terminal satisfies a predetermined condition, and moreover, the transmission
time differences of each of said base stations that have not been stored in said
storage means, or the difference between the current time and said calculation
10 time of said transmission time differences that have been stored in said storage
means satisfies a predetermined condition.

46. The transmission time difference measurement system according to claim 41, wherein, when said transmission time differences are already stored in said storage means, said control means calculates the average value of said transmission time differences that are already stored in said storage means and said transmission time differences that have been calculated, and stores this calculated average value in said storage means as said transmission time difference.